Delaware Space Grant Consortium
Lead Institution: University of Delaware
Director: Dr. Dermott J. Mullan
Telephone Number: 302-831-2170
Consortium URL: www.delspace.org
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Delaware Space Grant Consortium is a Program Grant Consortium funded at a level of $430,000 for fiscal year 2013.

PROGRAM GOALS

Consortium Goals and SMART Objectives from your 2010 base proposal and budget (or as amended in subsequent submissions)

Utilize NASA funds to serve students and teachers in the State of Delaware in a variety of educational and training projects in areas which are related to STEM-G. At the college level, provide fellowships and scholarships to students attending 2-year and 4-year colleges throughout the State and to aid in professional development of STEM-G related educators. Enhance research opportunities on and off-campus, during the academic year and summer. Recruit and provide support for the education and training of professionals especially women, underrepresented minorities, and persons with disabilities for careers in fields which will meet NASA's needs in the 21st century.

As an indication of the program goals which have been achieved, we may cite results from our Longitudinal Tracking: the percentage of students who have been successfully tracked though their next career step versus their last year of SG support, we can report that this percentage is 71% for 2006 and 59% for 2007, 79% for 2008, 75% for 2009, and 100% for 2010, 2011, and 2012. Figures are not available yet for 2013: all participants are still enrolled. A total of 89% of students significantly supported by DE Space Grant went onto next steps in STEM disciplines.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)

Provide concise, meaningful highlights or anecdotes (no more than three) that are directly related to work completed in 2013, highlighting student and/or project accomplishments. Specify alignment to an Outcome.

(1) In the area of Research Infrastructure Development (RID: Outcome 1), DESGC provided RID funding in FY13 to Dr. Jennifer Biddle, an astrobiologist on the Marine Studies faculty at the Lewes campus of the University of Delaware. Dr. Biddle's areas of research involve deep sea drilling to search for organisms in the sea floor, as well as studies of microbial colonies in a deep and isolated lake in the Canadian Rockies. Her participation in microbial studies at Pavilion Lake is part of a larger NASA analog mission to identify conditions in which primitive life forms can survive and flourish. Dr. Biddle's field work involves collecting samples of the microbes which populate regions in the lake at various depths, followed by genomic analysis in the laboratory. In FY13, Biddle brought honor to Delaware (and DESGC) when she was appointed to be 2013-14 Distinguished Lecturer with the U.S. Science Support Program, funded by the National Science Foundation. Lecturers are nominated by their peers in the International Ocean Discovery Program (IODP), which conducts marine geoscience research on drilling platforms around the world. Biddle is traveling throughout the United States from Florida to Oregon to discuss deep-ocean drilling science and her work on microorganisms living in deep within marine sediment. In total she will visit nine institutions. Her research uses samples obtained through IODP's drilling program and has appeared in *Nature* and *Proceedings of the National Academy of Sciences*. Biddle and her colleagues published findings in the prestigious journal *Nature* in 2013 showing that microbes live 500 feet below the bottom of the ocean, based an innovative genomic analysis of sediment drawn during an IODP mission in 2002.

(2) In the area of Outcome 2 *("Attract and retain students in STEM disciplines"*), DESGC has benefitted from the remarkable skills of a newly appointed Associate Director, Dr. Brian Chad Starks ("Chad"), who is on the faculty at Delaware State University (DE's HBCU). Although Chad is not personally involved in STEM research or activity (he is an Assistant Professor in the Department of Criminal Justice), his African-American heritage enables him to address underrepresented minorities (UMs) with credibility. So when Chad encourages them to consider applying for scholarship opportunities which they might not otherwise have bothered to apply for (because they were far out of their supposed reach), he is a convincing messenger. This is especially true since he himself obtained his PhD at University of Delaware, which (among the African-American community in certain areas of Wilmington DE) is perceived as a "white enclave". Chad contributed in a predominant way to the "Improvement Plan" which DESGC was asked to submit to NASA HQ in 2013 in order to address a deficit in the number of UMs among DESGC awards. At the National Space Grant Directors' Meeting in Crystal City in February 2014, Chad shared his ideas on the topic of "the messenger counts": the talk was extremely well received by the national audience. Several other Space Grant programs, as well as a number of administrators in NASA's Office of Education, have already scheduled meetings with Dr. Starks and are being very supportive.

Chad wins an award: on the campus of the University of Delaware (UD), on May 7, 2014, Chad was awarded the 2014 Louis L. Redding Award. This award was created to recognize individuals or units at UD whose efforts have promoted, enhanced and implemented diversity programs or activities that have resulted in a significant change in the campus climate and composition within the University community to recognize his contributions to the President's Diversity Initiative.

As regards Chad's effects on DESGC, Chad's efforts have led to dramatic improvements on the number of UM applicants for various awards. In the cycle of applications which occurred during FY13, among eight summer intern awards, 50% are UMs, and among 34 applicants for undergraduate tuition scholarships, 35.3% are UMs. DESGC has never previously seen such high percentages of UMs among the applications.

(3) In the area of Outcome 1 (*Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals*), we wish to highlight a former DESGC Graduate Fellow, A. Kate Gurnon. She graduated in May 2013 with a PhD in Chemical Engineering from University of Delaware, with a dissertation on how space suits can be improved using shear-thickening fluids to absorb micrometeorite impacts. Ms. Gurnon was one of three recipients for the best student poster award at the Annual European Rheology Conference (AERC) in Karlsruhe, Germany in April 2014. She has obtained a job with GE Global Research in the Nanostructures and Surfaces group in Niskayuna, NY and will be starting at GE this summer. In addition, she recently received the honor of being invited to give a talk at the Council for Chemical Research at their annual conference in May 2014. The council is comprised of over 100 of the top chemical companies, research institutes, and government labs that lead collaborative efforts to drive the future of chemical research. This year the conference is focused on the future of chemical research in 2050.

PROGRAM ACCOMPLISHMENTS

Refer directly to the consortium goals and SMART objectives in your 2010 base proposal when describing your accomplishments.

Administration: an affiliate of DESGC is now an MSI

One of the institutions which has been a member of DE Space Grant for several years, Wesley College, in Dover DE, has recently become classified as belonging to the Category "Minority Serving Institutions" (MSI). This is a new category for DESG: since 1991, we have always had an HBCU (Delaware State University) as an affiliate, but we have not hitherto been able to claim an MSI among our affiliates.

According to the DESG affiliate representative from Wesley College, Dr. Malcolm D'Souza, the rules to qualify as an MSI announce that once an institution contains 51% of more minority students, such an institution is considered an MSI. Currently, the student body as a whole at Wesley College consists of the following: 42% African-American, 45% Caucasian, 10% Hispanic, 1% Asian, and 2% mixed-heritage. In the

STEM fields, the Wesley demographics are: 49% African-American, 6% Hispanic, 31% Caucasian, 1% Native-American and 12% mixed-heritage. Combining the percentages of African-American and Hispanic among these numbers, Wesley clearly satisfies the 51% criterion whether we consider the student body as a whole (52%) or the STEM fields alone (55%).

The emergence of this news is especially timely for DESG at the present time: NASA is insisting that DESG must improve its commitment to diversity by making more awards to underrepresented minorities. The fact that DESG now contains not only an HBCU but also an MSI should contribute to more diversity among the awards which will be made.

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals:* (Discussion of achievements and progress related to your Fellowship/Scholarship, Higher Education and Research Infrastructure programs). *(Employ and Educate)*

(1) **Graduate Fellowships**

Six Graduate Fellowships were awarded in a competitive process in May 2013. One award went to a female student at Delaware State University (our HBCU), the remainder to UD (to the departments of Chemical Engineering, Materials Science and Engineering, Physics, and Electrical and Computer Engineering). One of the 6 awardees was female.

In addition, one graduate student (Erin Potter, female) was supported in Geography as a teacher in training to ensure that Delaware state standards in geography will be brought into the classroom.

Metric (Number of grad students supported): In Year 4 of our FY10 base proposal, DESGC had set as a goal full funding for 4.5 graduate fellows plus 0.5 grad students supported by Bartol Research funding. **We exceeded this goal**. **++**

Metric (Diversity, gender): Of the 7 graduate students supported in FY13 by DESGC, two (29%) were female. NASA's goal for female representation is 40%. **We did not satisfy this goal. --**

Metric (Diversity, ethnicity): In FY13, only one of our six grad awardees (17%) was African-American. According to NCES data, the total percentage of underrepresented minorities (UMs) enrolled in DE colleges is 29.0%. **We did not satisfy this goal. –** (We have been very much aware of our deficiencies in the Diversity area during FY13, and we have focused a lot of energy in improving the number of awards to UMs.)

(2) Undergraduate Summer Research

***Metric (DESGC support of undergraduates performing summer research on affiliate campuses)*:** In Year 4 of our FY10 proposal, our goal had been to offer DESGC support to five summer research students on affiliate campuses. **In FY13, we exceeded this**

goal. By leveraging with faculty sponsored research funds, DESGC was able to support six undergraduates in summer research in FY13. ++

Metric (DESGC Summer research Program for undergraduates at NASA Centers). In FY10/Year 4, we proposed that DESGC would support one student in a summer program at a NASA center. **In FY13, we exceeded this goal:** in FY13**,** two students were funded by DESGC at NASA centers, one at Goddard SFC and one in the LARSS program. ++

Metric (Diversity, gender): Among the eight students in FY13 Undergrad Summer Research programs, three (38%) were female. This comes close to **satisfying NASA's goal of 40% females**. +-

Metric (Diversity: students with disability): Among the eight students in FY13 Undergrad Summer Research programs, one was a student who is classified by Villanova University as having a learning disability. **We exceeded our expectations in this area.** ++

Metric (Diversity, African-Americans): Among the eight students in FY13 Undergrad Summer Research, two (25%) were African-American. **We did not satisfy the goal of reaching the DE state percentage of African-Americans in college (29%), although we came close. –+**
A contributing factor to this low number is that students at Del State University (Delaware's HBCU) have access to a large and active NASA-University Research Center (URC) for Applied Optics for Space Science: with a large amount of Grant funding at the URC ($5 million in total), there are many opportunities for undergrads from Del State to get summer research experience without help from DESGC.

(3) <u>Research Infrastructure Development</u>
In this section, we report on (a) the grant of DESGC/RID funds which was awarded in FY13 to Dr. Jennifer Biddle and (b) the process of strengthening our research links with NASA centers.

(a) Dr. Jennifer Biddle, Assistant Professor of Marine Studies, University of Delaware, operates an astrobiology laboratory on the Lewes campus of UD. In FY13, the Biddle laboratory was supported by DESGC RID funds in two ways: through research and graduate student funding. This support has been key in Dr. Biddle's ability to participate in a larger NASA analog mission, the Pavilion Lake Research Project (PLRP) in the Canadian province of British Columbia. She and her colleagues were able to participate in field work to collect samples, then perform genomics analysis in her laboratory. The work has resulted in two conference poster presentations, two conference oral presentations, and one peer reviewed publication. For the benefit of the members of the DE Space Grant Consortium Dr. Biddle presented the results of her work as the keynote speaker at our Annual Research Symposium which was held at Delaware State University (Delaware's HBCU) on April 11, 2014. She and her colleagues have submitted three proposals to continue the work with funding from government agencies, including the NASA Exobiology program. Since Biddle's involvement in PLRP has been targeted to

sample analysis, she has been able to leverage the existing team proposals from both NASA and the Canadian Space Agency to perform field sampling, using the DESGC funds to support the individual efforts of her team. (The DESGC administrator, Cathy Cathell, has been careful not to allow Dr. Biddle to charge Space Grant for funds which are used solely for foreign travel.) The team's efforts have led to a publication in an international journal and the process of this publication has led to Dr. Biddle joining the editorial board of the journal Geobiology. The DESGC provided funding support for graduate student Joe Russell in his early years of graduate training, and facilitated in his first peer reviewed publication on which he appeared as the lead author..

(b) Strengthening links with NASA Centers
Metric (Goddard): In Year 4 of our DESGC FY10 proposal, we had proposed to support at least one DESGC student at GSFC. **In FY13, we achieved this goal,** sending one student (Golden Rockefeller, African American male) to GSFC. **+**

Metric (Johnson): We had not planned in Year 4 of our DESGC FY10 proposal to have a student in the LARSS program. But in FY13, DESGC supported one student (Shaun Schaeffer, UD's Mechanical Engineering). **We exceeded our goal in this category. ++**

Metric (Diversity, gender): of the NASA Center grants awarded by DESGC in FY13, 0% was awarded to females. **We did not meet NASA's goal of female representation. -**

Metric (Diversity, underrepresented minorities): of the NASA Center grants from DESGC in FY13, 50% were awarded to African-Americans. **We exceeded NASA's goal of African-American representation (29% in DE)**. **++**

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty:* (Discussion of achievements primarily focused on your Higher Education programs not discussed in Outcome 1 and your Precollege programs). *(Educate and Engage)*

<u>Outcome 2: Higher Education</u>
(a) DESGC Graduate Student in Geography Teacher Training.
Metric: In Year 4 of DESGC's FY10 proposal, the budget provided funding for a grad student in UD's Geography Department to be used to expand NASA-based teaching resources (specifically satellite imagery) for classroom teachers in DE in support of DE's geography standards. In FY13, Erin Potter (female) was supported with DESGC higher-education funding for this task. **We satisfied this metric +.**

(b) DESGC funding for Community College students in rocket/balloon launch programs.
Metric: In Year 4 of FY10 proposal, our goal was to provide rocket-launch funding to 2 students at DE's 2-year college (DTCC). . **We satisfied this goal. +** In FY13, we provided DESGC funds to two DTCC (Dover) students (both African Americans) in Electrical Engineering Math & Science Concentration (to graduate from DTCC in 2014). These funds enabled the students, in the company of their professor, Mr. Joseph Pent (Instructor of Physics and Engineering Technologies at DTCC Dover), to attend Rock-On

at NASA's Wallops Island launch facility. A poster of their work was presented at the Annual Research Symposium in April 2014 by one of the students, Mr. Danley Pyle, who plans to move to the UD Newark campus in the summer and make the transition from an Associate's Degree to a Bachelor's degree.

Metric (Diversity, ethnicity): The percentage of underrepresented minorities (UMs) in DE colleges, according to NCES, is 29%. As regards DESGC awards for Rocket launches to students in Community Colleges, the percentage of UMs in FY 13 was 100%. **We exceeded the goal of awarding at least the NCES percentage in FY13. ++**

(c) Undergraduate tuition scholarships
Metric (Number of awards)*:* The goal in our Year 4 DESGC base proposal was to spend a total of $7,500 for undergraduate tuition scholarships (UTS) to three students at DTCC (Delaware's Community College) and $21K for seven awardees at non-DTCC campuses. In FY13, we awarded only two UTS to DTCC students. **We did not satisfy our goal in UTS awards to DTCC students. –** The reason for our failure in this regard is, in part, due to the fact that the state of Delaware now offers a very generous scholarship package (covering 100% of tuition) to students who graduate from schools in DE and enter into DTCC as full-time students right after graduation. As a result, DTCC students need DESGC support less than they used to.

As regards UTS for non-DTCC students, **we exceeded the metric for the Year 4 proposal for non-DTCC students:** DESGC in FY13 provided UTS to seven students at non-DTCC schools. **We satisfied this goal.** +

Metric (Distribution among affiliates)*:* Of the two DTCC students, one award went to the Stanton campus and one went to the Terry campus. As regards the seven non-DTCC awardees, one was at Del State (our HBCU), one was at Wilmington University, and five were at UD. **We satisfied the goal of distributing UTS widely among affiliates. +**

Metric (Diversity, ethnicity): The percentage of underrepresented minorities (UMs) in DE colleges is 29%. **We failed to achieve this metric in UTS awards in FY13:** of the nine awardees, two (22%) were UMs (one African-American at Del State, one Hispanic at UD). -

Metric (Diversity, gender): Of the nine UTS awardees in FY13, two (22%) were female. **We did not satisfy NASA's goal for female awardees in this category. –**

Metric (DTCC Diversity): Our two-year affiliate Delaware Technical Community College (DTCC), although not officially an MSI, includes a more representative population of underrepresented minorities among the student body on its State-wide campuses than UD. In FY13, the DESGC goal was to have at least one UM supported with UTS at DTCC, but neither of the awardees was UM. **We failed to achieve this metric. -**

Metric (DSU Diversity): The goal for DESGC in FY13 was to have at least one UM undergrad tuition scholar at Del State University (Delaware's HBCU). One student

(Jeremi Frazier, African American male) at Del State University received an UTS. **We satisfied this metric**. **+**

<u>Outcome 2: Pre-college Programs</u>.

DESGC Programs which are aimed at professional development of teachers are operated by Dr. Stephanie Wright, founder and CEO of the Delaware Aerospace Educational Foundation (DASEF). Founded in 1989, DASEF is an independent non-profit education organization which functions to raise the visibility and value of K-12 STEM education so as to meet intellectual and workplace needs of the future. DASEF implements successful programs using proven instructional strategies to motivate, engage, educate and inspire students from diverse backgrounds and communities in Delaware. DASEF's vision is driven by the belief that "Wisdom Begins with Wonder." Capitalizing on natural curiosity through activities that include a problem solving component enriches the learning process for participants. Since 1989, DASEF has established itself in Delaware as an innovative and progressive organization with the vision and resources required to link contemporary aeronautic, space, and engineering themes with traditional school subjects to increase interest in science and technology.

Dr. Wright's programs which were operated with DESGC support in FY13 were as follows.

STEM Curriculum for Teachers: This program is designed to assist teachers as they use STEM curriculum in their classrooms during the school year. STEM Curriculum is distributed to participating teachers in Delaware. This program includes a "teacher self-training" based on the NASA materials and curriculum handbooks that focus on specific STEM materials. All teachers accompanying field trips to the Outpost are given teacher packets containing NASA materials. Mailings are sent and distributed to all schools at least once a year. Approximately 1,175 educators from 96 schools within the State of Delaware were served through this program.

Delaware Aerospace Academy (DAA) Destination Moon and Mars (July 2013): In operation since 1990, the objective of the DAA is to provide hands-on training and experiences through our Destination academies in related activities and fields. Throughout the week, students in grades 1 - 10 are continually challenged to think, create, solve, build, and work cooperatively. Curriculum used in the academies is standards based and designed to integrate the study of science, technology, engineering, and mathematics using Earth and Space Education as the unifying framework. Current STEM/NASA themes and content are integrated into the curriculum and participants and staff are informed of current NASA opportunities, mission activities programs and opportunities throughout the year. In 2013, 93 students participated and 9 teachers and pre-service teachers were mentored.

Astronomical Society of the Pacific (ASP) Conference, San Jose CA (July 20-24, 2013): As a non-profit membership organization, international in scope, the ASP's mission is to increase the understanding and appreciation of astronomy to advance

science and science literacy. By participating in this conference, all Delaware Aerospace Education Foundation (DASEF) programs and activities benefit.

DASEF Solar System Workshop (October 5, 2013): The Solar System Workshop is designed to introduce teachers to NASA Educational Products related to content for the Solar System, Seasons, and Rocketry. Educators are expected to discuss how solar system and NASA knowledge will assist them in their standards based curriculum and in teaching science process skills.

Space Community Outreach (October 26, 2013): Program open to the public where attendees were able to participate in a variety of activities, including rocket launching demonstrations, solar viewers, moon boots, designing a lunar rover, spinning device, ILC Dover's spacesuit, orbital hoops, StarLab experience, see NASA moon rocks and meteors, and learn about the planets by taking the Scaled Planetary Walk.

Earth Systems Workshop (November 6, 2013): This activity was geared toward K-5th grade and pre-service teachers and focused on the understanding of how the Earth's systems interact and on how we can best manage the world around us without dramatically impacting the planet's ecosystems and disrupting the balance of nature. This workshop will introduce educators to earth systems and remote sensing through the investigations and resources provided. The workshop training will include the use of Earth Walk, a 16' x 20' floor map of the continental United States which features a high resolution satellite image with true life earth colors. Educators will learn about DASEF's new Earth Ball Outreach Program. Appropriate NASA materials and resources will be distributed.

., (February 11, 2014): Participants look back at the Earth and out into the Universe. They experienced the StarLab, observed the stars in the Mountjoy Observatory using DASEFs 16 Meade Telescope. They constructed their own Galileoscope telescopes and viewed the constellations and planets. NASA materials and resources were distributed.

NGSS: Overview and Applications (March 12, 2014): This professional development workshop gives teachers an overview of the NGSS and presents them with sample lessons and activities that can be used in the classroom. The activities are based on the core ideas in science, scientific and engineering practices, and the crosscutting concepts, which are at the center of the NGSS. Resources were provided that enable teachers to further study the new standards. A goal of the workshop is to have participants engage in scientific and engineering practices, giving them the tools to teach their students the approaches that scientists and engineers use to investigate, model, and explain the world. It is also a goal of the workshop that teachers will be more comfortable with integrating STEM education in their classrooms. NASA materials and resources were distributed.

Training of a graduate student in Geography Education. An ongoing DESGC Program which is aimed specifically at professional development of a teacher in the field of Geography was awarded in FY13 to Erin Potter. Working in the Geography Department on the UD Newark campus, and in collaboration with the DE Geographic

Alliance (DGA), Ms. Potter learned how to prepare materials and how to implement them in the classroom. The first project to be worked on was to research and prepare a poster presentation for Delaware's Coast Day which attracts thousands of visitors to the Lewes campus of UD on a weekend in the fall. The theme was modern day explorers, and the goal of the poster presentation was to inspire the young of the community to get into science exploration, and also to show the public that we have local modern day explorers right at UD. For this project, scientists were highlighted from a national sample, as well as among the scientists in UD's Marine Studies program. As Ms. Potter comments: "I have learned that this is a huge part of teaching, i.e. creating a presentation or teaching materials that are geared towards a particular age range". A second project was centered on creating for the first time a digital inventory of all the maps in the DGA archives. Aspiring Geography teachers in DE now have available to them a properly organized and digital guide to the teaching materials which are available to them: this information will be uploaded onto the DGA website for teachers to access from any location in the state. The third project was to sort through a previous kit of teaching material on the Urban Heat Island effect. Ms. Potter's work has now provided the DGA with digital copies, rather than the previous paper format.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission:* (Achievements and progress of Informal Education programs). *(Engage and Inspire)*

Outcome 3: Informal Education

DESGC offers the following informal education opportunities to engage and inspire.

Rocketry Outreach: Dr. Stephanie Wright organized this statewide rocketry program designed to assist participants as they use rocketry as the unifying theme for learning about STEM and non-traditional career choices, skills, and technology. Rocketry curriculum is shared with participants throughout the state of Delaware. This program includes activities, lessons, and a "how to guide" to construct the various rockets. Participants construct and launch their rockets.

Space Community Outreach (October 26, 2013): Dr. Stephanie Wright led this program that was open to the public where attendees were able to participate in a variety of activities, including rocket launching demonstrations, solar viewers, moon boots, designing a lunar rover, spinning device, ILC Dover's spacesuit, orbital hoops, StarLab experience, see NASA moon rocks and meteors, and learn about the planets by taking the Scaled Planetary Walk.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:**
  Total awards = 25; Fellowships = 6 (grad); Higher Education = 10; Summer Research Awards = 9. Of the 25 awards, 32% were made to females and 28% to underrepresented/underserved minorities. During the FY13 program year five

students are pursuing advanced degrees in STEM disciplines, one accepted a STEM position at a NASA contractor, 18 accepted STEM positions in industry, one accepted a STEM position in K-12 academia, five accepted STEM positions in academia, and two went on to positions in non-STEM disciplines. The remaining students have not yet received the degree that they were pursuing when they received their Space Grant award.

- **Minority-Serving Institution Collaborations:** Summarize interactions. Reference the names of projects with MSI collaborations.

During FY13, the DESGC Director was informed for the first time by the Affiliate Representative that one of our affiliates, Wesley College, is now classified as a Minority Serving Institution (MSI). This is the first time that the annual report from DESGC contains any reference to MSI participation. In FY13, for the first time, DESG provided funds so that a faculty member (Dr. Derald Wentzien) in the Mathematics Department at Wesley could support a (female) student (Kasey Thompson) as a summer research intern on a problem of interest to NASA. The problem that Ms. Thompson worked on was a "calculus-based approach to estimate the volume of asteroids". Images of asteroids on the NASA website were downloaded and pixel counts from MS Paint were used to determine a set of x-y coordinates for the pixels which define the profile. These coordinates were then fitted with polynomials of various degrees. 36 asteroids were located with suitable images, and regression analysis was used to get the best fitting polynomials. 50% of the asteroids were found to be fitted well (statistically speaking) by polynomials of degrees ranging from 6 to 8, with regression values of 0.95-0.999. Using calculus, the best fitting profiles were converted to volumes. Ms. Thompson presented a poster with the results of her work at the DESGC Annual Research Symposium at Del State University in Dover DE on April 11, 2014.

- **NASA Education Priorities:** *Accomplishments related to the "Current Areas of Emphasis" stated in the 2010 Space Grant solicitation. Report on areas that apply to work proposed in your proposal and budget.*

  - Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.

In FY13, DESGC sponsored a student (Vincent D'Occhio, UD Mechanical Engineering) in the 2013 Helicopter/UAV Workshop held on the campus of Central Connecticut State University. This hands-on program included classes on helicopter flight and UAS (unmanned aerial systems), and designing and building an RC aircraft. Each of the 7 groups' individual and uniquely-designed aircraft was tested, and Mr. D'Occhio's group's aircraft won based on its ability to fly successfully and with the most control. In addition, the student was flown in a Bell 500 helicopter to experience the pitch, roll, and yaw of the flight systems, and toured Kaman Aerospace and the Sikorsky Aircraft plant.

Mr. D'Occhio described the workshop as "an amazing experience where I built awesome relationships with the people around me while learning so much about aerodynamics and how helicopters are designed".

Also in FY13, DESGC sponsored a student (Shaun Schaeffer, UD Mechanical Engineering) who participated in the Langley Aerospace Research Student Scholars (LARSS) Program at NASA's Langley Research Center. Mr. Schaeffer worked on research to create a layout for surface acoustic wave (SAW) sensors, a microelectromechanical system (MEMS) device that uses metal and piezoelectric material to generate a mechanical wave that changes frequency when certain conditions are placed upon it, and to develop new ways of deploying them in space. Creating the sensors requires a computer program that allows the user to first draw them, a netlist is created from that drawing; and finally, a machine and other processes used to produce the sensors. This project aids NASA's efforts in researching SAW sensors and in maintaining flight structures both in and above the atmosphere.

- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).

DESGC is comprised of a variety of institutions including an HBCU (Delaware State University), an MSI (Wesley College), and a 4-campus community college (Delaware Technical Community College). DESGC sponsored 29 students (significantly and non-significantly-funded) of which 27% were female and 38% were underrepresented/underserved. **With 38% of all DESGC awards in FY13 going to UMs, DESGC exceeded the NCES criterion (29%): ++. But the awards to females fell short of NASA's goal (40%): -.**

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).

Work in these areas was undertaken in FY13, with funding from DESGC, by Dr. Stephanie Wright. For descriptions, see pp. 8-9 above.

- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.

Delaware Futures is an organization which places at-risk high school students in college research groups for a period during summer so that the students can be encouraged to continue STEM education. DESGC Assoc. Director Michael Shay, who has in the past supported one such student, mentored a DESGC-sponsored student (Munzer Suliman, African-American male) during FY13. The student learned the basics of science research, designed and performed scientific experiments, and prepared an oral

presentation where he outlined a proposal for science study and answered questions about method, feasibility, and cost.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

Connections between DESGC and all 4 campuses of the Community College system (DTCC) in the state of Delaware are excellent. Affiliate reps on each campus keep their students well informed about DESGC funding opportunities. From each of the campuses, we cite the following as examples: (a) Georgetown campus: one student in FY13 had a DESGC-supported summer research internship; (b) Stanton campus: one student received an Undergraduate Tuition Scholarship; (c) Dover campus: one student received an Undergraduate Tuition Scholarship and two students (African-American males) plus a faculty member participated in RockOn! at Wallops Island launch facility; (d) Wilmington campus: the affiliate representative serves as a reviewer of NASA/EPSCOR proposals in the state of DE.

Regrettably in FY13, Dr. Douglas Hicks, who had served DESGC for several years as Affiliate Representative of the DTCC Georgetown campus, chose to retire on December 2013. Dr. Hicks had developed a very productive relationship with DESGC: four of his students obtained summer research internships from DESGC at the Marine Studies campus of UD in Lewes DE. The Georgetown students were involved in fabricating an instrument which was used successfully to extract particles of various sizes from the vicinity of hot thermal vents on the floor of the Atlantic Ocean. A replacement representative for the DTCC Georgetown campus had to be found. Although the name of David Pedersen (Instructional Coordinator, Engineering Technology) was at first suggested by Dr. Hicks, Mr. Pedersen suggested Brent Mitchell (Department Chair, Electronic and Computer Engineering Technology) as potential affiliate representatives. Director Mullan drove to the Georgetown campus on April 16 to meet with Mr. Mitchell, but at the last minute met with Mitchell Parson (Instructor in Electronics Technology), who was filling in for a temporarily unavailable Mr. Mitchell. It remains to be seen who will surface as the new Affiliate Rep for DESGC on the DTCC Georgetown campus.

- Aeronautics research – research in traditional aeronautics disciplines; research in areas that are appropriate to NASA's unique capabilities; directly address the fundamental research needs of the Next Generation Air Transportation System (NextGen).

No efforts along these lines occur in DE.

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

An FY13 Graduate Fellowship recipient's (Jesse Samluk, UD Electrical & Computer Engineering) research involves working with an electromagnetic induction instrument to

determine the thickness of sea ice. Mr. Samluk presented his research entitled "3D Electromagnetic Induction Field Simulations of Level and Deformed Sea Ice" at the 8th Annual DESGC Research Symposium held April 11, 2014. The results based on his work have been submitted for publication in the journal *Annals of Glaciology* and were also presented at the International Glaciological Society's Symposium on Sea Ice in a Changing Environment held in Hobart, Australia, during March 2014.

- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.

On pp. 5-6 above, we have described how DESGC funds in FY13 were awarded for Research Infrastructure Development to an early career faculty member Dr. Biddle, Assistant Professor of Marine Studies, University of Delaware. In FY13, the Biddle astrobiology laboratory on the Lewes campus of UD was supported by DESGC RID funds in two ways: through research and graduate student funding. This support has been key in Dr. Biddle's ability to participate in a larger NASA analog mission, the Pavilion Lake Research Project (PLRP) in the Canadian province of British Columbia.

IMPROVEMENTS MADE IN THE PAST YEAR

Succinctly *describe improvements and/or adjustments made last year that demonstrate significant change(s) within the consortium. The improvements and/or adjustments that brought about change may have been in management, resource allocation, project design, project evaluation, etc.*

A major focus of the efforts of DESGC during FY13 has been the Improvement Plan which was prepared during FY12 to increase the number of DESGC awards to underrepresented minorities (UMs). A second draft of the Plan was submitted to the Program Manager of Space Grant (Diane DeTroye) at NASA HQ on April 30, 2013. Throughout the entire 12 months which have elapsed since April 2013, we have received no written or electronic communication from NASA HQ to indicate whether or not our Improvement Plan has been accepted by the national Space Grant office. Nevertheless, we have proceeded under the assumption that the DESGC Improvement Plan has been accepted by NASA HQ.

When the academic year 2013-2014 started, the new Associate Director of DESGC (Dr. B. Chad Starks), who had been appointed specifically to address the Diversity issue, began to address STEM students at Delaware's HBCU (Delaware State University [DSU], in Dover DE) to encourage them to apply for undergraduate and graduate funding from DESGC when the opportunities would arise. Dr. Starks (who is a faculty member in a non-STEM department) established working relationships with another Associate Director of DESGC (Dr. Cherese Winstead) in the Chemistry Department at DSU. With assistance from Dr. Winstead, and also from Dr. Boukari in the Physics department, Dr. Starks spoke to classes of undergraduate DSU students in physics and chemistry, pointing out to them the possibilities of obtaining DESGC funds from two distinct sources. First,

summer research internships on and off the DSU campus, and second, undergraduate tuition scholarships (UTS) which help to pay tuition during the academic year.

The results of these efforts by Dr. Starks have been remarkably positive. Out of a total of eight summer research interns who will be funded by DESGC in summer 2014, 50% will be African-American. This is a higher percentage than we have ever seen in DESGC summer interns before. And as regards the UTS, we have received a larger number (34) of applications than we have ever received before. And even more striking, out of the 34, we have applications from 12 UMs: nine African Americans and three Hispanics. DESGC has never previously received as high a percentage (35.3%) of UTS applications from UMs.

Also, thanks to a suggestion of Dr. Starks, the DESGC Annual Research Symposium (which is held each year to hear reports from all students and faculty who have been awarded DESGC funds for research in the current year) was held in FY13, for the first time, on the campus of Delaware's HBCU. Prior to this year, the Symposium had been held only at the lead institution of DESGC, i.e. on the Newark campus of the University of Delaware. But on April 11, 2014, Delaware State University served as the host. The Symposium was held on a school day, and in a central location on the DSU campus, so that students could drop in at any time to see what was going on as regards NASA funding in the state of Delaware.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

List the institutions that comprise the consortium; include the name, type of institution, key characteristics, and role.

(1) 4-year academic institutions:
(a) The lead institution of DESGC is the University of Delaware [UD]. UD is classified by the Carnegie Foundation for the Advancement of Teaching as a research university with very high research activity, a designation accorded to fewer than three percent of the more than 4,200 degree-granting institutions in the USA. Currently, UD has 17,719 undergrads and 3,679 grad students enrolled, and offers bachelor degrees in all STEM-G subject areas. Most of the DESGC graduate fellows are UD students from a variety of colleges: Arts & Sciences (Departments of Physics & Astronomy and Geography) and Engineering (Departments of Chemical, Electrical, and Materials Science). UD undergraduates from a variety of colleges have benefitted from DESGC-funded tuition scholarships and summer research opportunities. Researchers in various colleges (Engineering, Earth, Ocean & Environment, Arts & Sciences) and the Delaware Biotechnology Institute [DBI] have benefitted since 2005 from DESGC Research Infrastructure (RID) Funds.

(b) Delaware State University [DSU], an MSI, has 3,955 undergrads, 470 grad students, and offers bachelor degrees in at least one STEM-G area. The student body is 73% underrepresented minorities. One of the FY13 DESGC grad fellows is a DSU student

(Ms. Alissa Mezzacappa), one DSU undergrad was awarded a DESGC tuition scholarship, and one student was the recipient of summer research funding.

(c) Swarthmore College [1,534 undergrads] offers bachelor degrees in at least two STEM areas. The student body is 20% underrepresented minorities and 51% female. In FY13, one Swarthmore student (female) was the recipient of summer research funding.

(c) Wilmington University [10,992 undergrads, 6,232 grads] offers a range of bachelor degrees which includes one or more of the STEM-G disciplines. In FY13, one WU undergrad (disabled male) was the recipient of a DESGC tuition scholarship. WU's student body is 66% female and 27% underrepresented minorities.

(d) Wesley College [1,386 undergrads] offers a range of bachelor degrees in the STEM-G disciplines. 43% of the undergraduate student body are underrepresented minorities, and 53% are female. In FY13, DESGC supported one undergrad (female) in summer research.

(f) Villanova University [6,547 undergrads, 3,655 grads] is a DESGC affiliate in the southeastern corner of PA. In FY13, one undergrad was the recipient of summer research funding. 50% of the student body is female.

(2) 2-year Academic Institutions
Delaware Technical Community College (DTCC) has a total of nearly 15,000 students on four campuses distributed widely across the State. The average student body includes 31% underrepresented minorities and 57% female. In FY13, two DTCC students received DESGC-funded tuition scholarships and one student was supported in summer research.

(3) Delaware AeroSpace Education Foundation (DASEF) is an enterprise founded in 1989 by Dr. Stephanie Wright (at one time, Delaware's Teacher in Space) to create an exceptional learning environment that inspires children and their families with an appreciation of the Earth and its place in the universe. DASEF has contributed to the academic development of over 300,000 students, educators, and the general public through the delivery of context-based activities consistent with current aerospace research and development.

(4) Industrial affiliates: ILC Dover (makers of space suits for NASA), E.I. DuPont de Nemours, and ATK (Thiokol) Elkton supply active members to DESGC's Advisory Board. Activities of these board members include reviewing applications for DESGC Graduate Fellowships and providing a detailed statistical analysis of the results to ensure a lack of bias among reviewers.

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.